

MAHRS: A simple instrument suite to characterize weathering and the habitability of the shallow martian subsurface

Completed Technology Project (2013 - 2016)

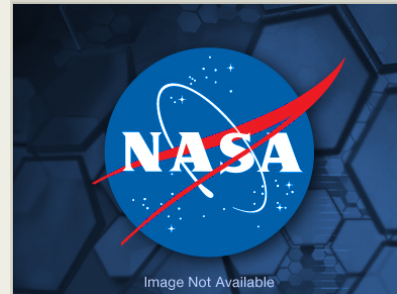


Project Introduction

The shallow martian subsurface is extremely interesting as a possible microbial habitat because there is evidence that it becomes temporarily wet, that it is shielded from radiation, and that mixing by aeolian processes might provide the energy and nutrients (chemicals) necessary for sustaining microbial life. We propose to mature the Martian Aqueous Habitat Reconnaissance Suite (MAHRS) to prepare it to study weathering processes and search for potentially habitable environments in the shallow subsurface of Mars and other planetary bodies. Aeolian abrasion is one of the most important currently active weathering processes on Mars. It also has important implications for habitability because, along with the transport of minerals by the wind, aeolian abrasion provides a means for the exchange of nutrients and energy sources between the atmosphere and the shallow subsurface. The growth of segregated ice and salt crystals in rock pores is a critical weathering process on Earth, and there is evidence that this process is currently active on Mars. Salts inhibit the exchange of moisture with the atmosphere and cement the soils of arid places such as MAHRS test sites--the McMurdo Dry Valleys in Antarctica, the Owens Dry Lake in California, and the Atacama Desert in Chile--and probably the regolith of Mars and of other arid planetary bodies. Salts have the potential to create pockets of wet regolith in the shallow martian subsurface that could be habitable and easily accessible by a robotic mission. Moisture cements the regolith, inhibiting saltation and reducing weathering by aeolian processes. MAHRS includes several sensors developed by our group during the past decade, including electric field sensors, optical microscopes, and radiometers developed to study saltation and dust transport. In addition, MAHRS includes a sensor to measure regolith wetness and to search for brines in the shallow subsurface, where they are more likely to be found. The measurements of regolith wetness and detection of brines have promise for shedding new light into aqueous weathering processes and habitability. In addition to maturing instruments developed by the MAHRS team over the last decade, the MAHRS project leverages Small Business Innovation Research (SBIR) work. MAHRS responds to the top priorities of the 2013-2022 Decadal Survey and the 2007-2016 Science Plan for NASA's Science Mission Directorate by maturing instruments for detecting potentially habitable zones in the shallow martian subsurface and for studying the exchange of matter between the atmosphere, the surface, and the shallow subsurface. MAHRS also could aid in the selection of optimum areas for sample collection on Mars for return to Earth. In addition, MAHRS could make in situ measurements on Europa in support of investigations of Europa's habitability.

Anticipated Benefits

Decadal Survey Missions



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Organizational Responsibility

Responsible Mission Directorate:

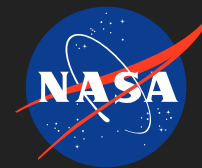
Science Mission Directorate (SMD)

Responsible Program:

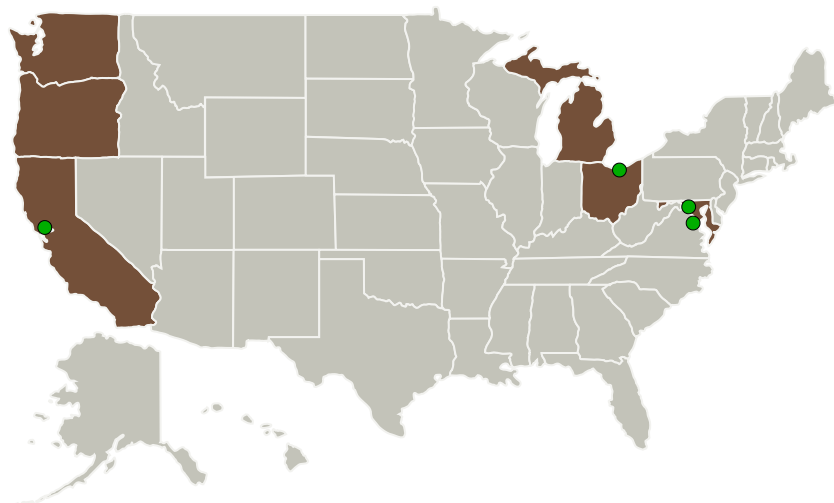
Maturation of Instruments for Solar System Exploration

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
● Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio
● Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland
● NASA Headquarters(HQ)	Supporting Organization	NASA Center	Washington, District of Columbia
Ohio Aerospace Institute(OAI)	Supporting Organization	Academia	Cleveland, Ohio
Oregon State University	Supporting Organization	Academia	Corvallis, Oregon
University of Michigan-Ann Arbor	Supporting Organization	Academia	Ann Arbor, Michigan

Project Management

Program Director:

Carolyn R Mercer

Program Manager:

Haris Riris

Principal Investigator:

Nilton D Renno

Co-Investigators:

Michael J Krasowski

Joseph Flatco

Martin R Fisk

Ronald S Sletten

George E Ponchak

Norman F Prokop

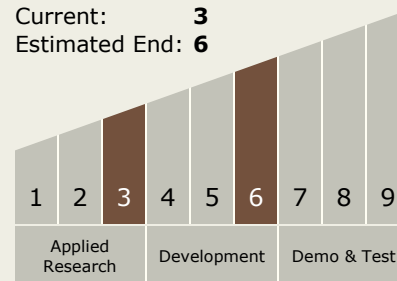
Brent J Bos

Christopher P McKay

Bernard Hallet

Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **6**



Technology Areas

Primary:

- TX08 Sensors and Instruments

Continued on following page.

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Primary U.S. Work Locations

California	Maryland
Michigan	Ohio
Oregon	Washington

Technology Areas (*cont.*)

- └ TX08.1 Remote Sensing Instruments/Sensors
- └ TX08.1.3 Optical Components

Target Destination

Others Inside the Solar System